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INSTRUCTION MANUAL
HB-815

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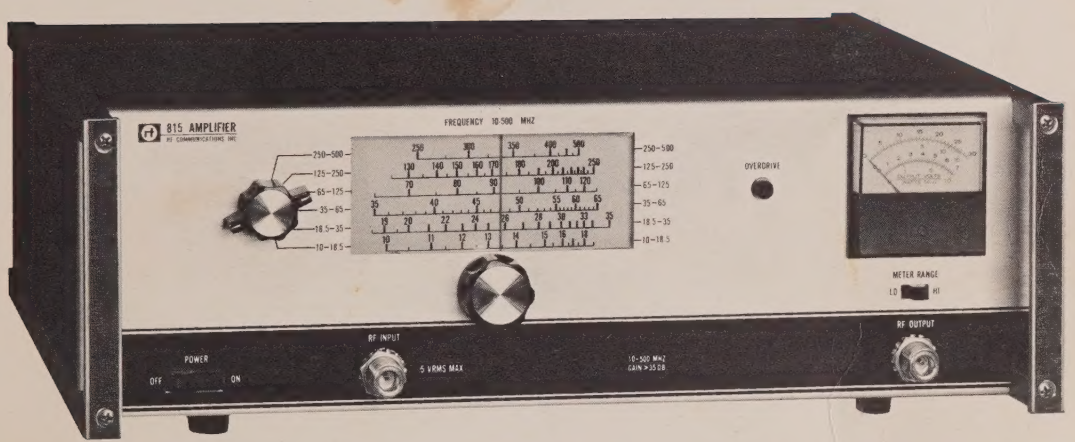

RF-815
AMPLIFIER

RF COMMUNICATIONS, INC. ■ ROCHESTER, NEW YORK, U.S.A.

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WARRANTY

The Electronic Instrumentation Operation of R F Communications, Inc. warrants each new instrument to be free from defects in material and workmanship for a period of one year after shipment. Repair or replacement, at our option, without charge (f.o.b. factory) will be made when our examination indicates that defects are due to workmanship or materials. Electron tubes, semiconductors, batteries, fuses, and lamps are excluded from warranty coverage. All warranty returns must first be authorized in writing by the factory.

This warranty does not apply to any of our products which have been repaired or altered by persons not authorized by R F Communications, Inc. or not in accordance with instructions furnished by us. If the instrument is defective as a result of misuse, improper repair, or abnormal conditions or operations, or if any serial number or seal has been removed or altered, the warranty is void and repairs will be billed at cost.

This warranty is in lieu of all other obligations or liabilities expressed or implied and R F Communications, Inc. neither assumes, nor authorizes any person to assume for them, any other liability in connection with sales of its instruments.

REPAIR & MAINTENANCE

Instruments should be returned only upon prior written authorization from the Electronic Instrumentation Operation of R F Communications, Inc. or its authorized sales and service representative. Warranty repair will be made upon written request. Please provide the following information in order to enable us to serve you efficiently:

1. Model or type
2. Serial number
3. Description of trouble
4. Approximate number of hours of use

Upon receipt of this information our service department will send you service data or shipping instructions. Return shipment must be made in original packing material or equivalent (at least 2 inches of foam completely surrounding unit).

For assistance contact your nearest R F Communications sales representative.

CHAPTER 1
INTRODUCTION

1.1 GENERAL DESCRIPTION.

The RF-815 is a tunable power amplifier designed to increase the rf power level of signal generators operating in the 10 - 500 MHz frequency range. It operates in six bands, and employs a two-speed vernier tuning mechanism for tuning within each band. Power gain is sufficient to provide an output power of up to 4.5 watts with common signal generators presently in use. The signal may be modulated with AM, FM, SSB, CW, or Pulse Modulation.

Solid state broadband circuitry is employed in the low level stages, while a single tube with a relatively simple tuned circuit are used in the output amplifier stage. Power supplies and control circuitry employ only solid state devices. RF output metering is provided in two ranges. A unique overdrive protection circuit prevents overdrive damage to the Amplifier or output levels exceeding approximately 120% of the selected metering range. A lamp illuminates to indicate the status of the overdrive protection circuit.

The RF-815 is normally housed in an aluminum cabinet for bench use. The Amplifier can also be rack mounted, with or without chassis slides. RFI filtering and tight shielding prevent stray radiation. Cooling is accomplished through circulation of ambient air by an internal fan. An air filter is provided on the rear panel. Primary power is single-phase, 50/60 Hz, 115 VAC or 230 VAC (selected by a rear panel switch).

1.2 APPLICATIONS.

The RF-815 Amplifier is intended for use in 50 ohm systems. When used with a properly matched load, it will produce up to 4.5 watts of rf power with nominal input drive provided by signal generators such as the R F Communications model RF-808 and Hewlett-Packard models HP-606 and HP-608. Virtually any signal source within the frequency range of the Amplifier may be used; including special purpose FM and navigation aid signal generators, crystal oscillators, breadboard models of engineering projects, frequency synthesizers, Q meters, RX meters, and so on. Applications for the Amplifier are almost unlimited. Some of the more common uses are testing receivers at high signal levels; calibrating voltmeters; testing antennas, feed-lines, and antenna couplers; driving transmitters; driving varactor multipliers and high level mixers; checking bandpass filters and RFI devices; testing shielding and screen rooms; and use as a transmitter to make tests with radiated signals. The bandwidth of the Amplifier is wide enough to allow use with most forms of modulation (1.5 MHz minimum) and to make tuning non-critical, but it is narrow enough to provide excellent harmonic rejection.

1.3 SPECIFICATIONS.

Nominal physical and electrical specifications are as follows:

FREQUENCY RANGE:

Band 1	10 to 18.5 MHz
Band 2	18.5 to 35 MHz
Band 3	35 to 65 MHz

Band 4 65 to 125 MHz
Band 5 125 to 250 MHz
Band 6 250 to 500 MHz

BANDWIDTH (at 10 volts into 50 ohms):
Greater than 1.5 MHz (10 to 150 MHz)
Greater than 3.0 MHz (150 to 500 MHz)

RF GAIN (at 10 volts into 50 ohms): 34 db minimum.

INPUT IMPEDANCE: 50 ohms (VSWR less than 1.5:1).

OUTPUT: Up to 15 volts into 50 ohm load (4.5 watts).

CONNECTORS: Type "N" Female.

METERING:
Ranges - 5 & 20 volts rms full scale.
Voltage Accuracy - $\pm$ 1.5 db.

FREQUENCY CALIBRATION ACCURACY: $\pm$ 10%.

AM REPRODUCTION: Reproduces 0 to 100% modulation. Less than 10% added to distortion of driving source at up to 5 volts carrier output for up to 100% modulation.

FM REPRODUCTION: Reproduces modulation of driving source up to bandwidth limit (see BANDWIDTH). Less than 10% incidental AM added to modulation of driving source at 150 KHz deviation. FM distortion is negligible for less than 150 KHz deviation and modulation frequencies.

SIZE: $5\frac{1}{4}$" H, 17" W, $14\frac{1}{4}$" D.

WEIGHT: 25 pounds.

POWER REQUIREMENTS: 115 or 230 VAC $\pm$ 10% (selected by rear panel switch) 50/60 Hz, single-phase, 150 watts maximum.

1.4 ACCESSORIES.

A rack mount kit, R F part number 815-0114 is available to extend the panel to 19 inches for mounting in a standard rack cabinet. A chassis slide kit, R F part number 815-0115 is also available as an option, to be used in addition to the above rack mount kit, so that the Amplifier can be extended from the cabinet.

CHAPTER 2
PREPARATION

2.1 INITIAL INSPECTION.

2.1.1 MECHANICAL CHECK.

If damage to the shipping carton is evident, ask that the Carrier's Agent be present when the instrument is unpacked. Check the equipment for damage, and inspect the cabinet and panel surfaces for dents and scratches.

2.1.2 CLAIM FOR DAMAGE.

If the RF-815 Amplifier is mechanically damaged or fails to meet specifications upon receipt, notify the Carrier and the nearest R F Communications, Inc. representative immediately. Retain shipping carton and packing material for the Carrier's inspection as well as subsequent use in returning the unit if necessary. For assistance at any time, including assistance with instruments under warranty, contact your R F Communications, Inc. representative.

2.1.3 PERFORMANCE CHECK.

The electrical performance of the RF-815 Amplifier should be verified as soon as possible after receipt. Following is a performance check that is suitable for incoming inspection.

2.1.3.1 Test Equipment.

Test equipment required for the performance check is as follows:
Signal Generator, HP-608F or equivalent, 10 - 480 MHz, frequency accuracy ±2%.

RF Dummy Load, 50 ohms, 2 watts minimum average power rating, General Radio W-50B or equivalent.

Coaxial Attenuator, 20 db, General Radio 874-G20 or equivalent.

R F Voltmeter, Hewlett-Packard 3406A with 11063A Tee Probe Adapter, or equivalent.

2.1.3.2 Initial Turn-on Check.

a. Check that the 115/230V switch on the rear panel is in the correct position, and check that the fuse is of correct value and not blown. (See section 2.2.1.)

b. Remove the top cover of the amplifier.

c. Visually inspect the entire assembly for evidence of damage or mechanical failure such as:

(1) Covers, handles, panels, or frame scratched or dented.
(2) Loose subassemblies or hardware.
(3) Broken components.
(4) Frayed, pinched, loose, or broken harness wires.
(5) Loose or shorted printed circuit boards.

d. Replace covers, and secure.

e. Plug in line cord with the POWER switch off. Check that the bandswitch is in a detent position.

f. Set Amplifier front panel POWER

switch to the ON position, and quickly check that the power switch illuminates and that the fan motor runs. The OVER-DRIVE lamp should not be lit.

CAUTION

Turn the POWER switch off immediately if positive results are not obtained.

g. Turn the POWER switch off.

NOTE

Read through Chapter 3 before proceeding.

2.1.3.3 Frequency Dial Accuracy.

a. Use test setup shown in Fig.2-1.

b. Set signal generator at each of the frequencies listed in table 2-1, with sufficient CW output level to drive the Amplifier to 3 - 4 volts output. Use the low meter range on the Amplifier, and adjust drive level from generator if necessary to avoid overranging the meter.

c. At each frequency, set the Amplifier band selector and vernier tuning controls for the test frequency, and then peak the vernier tuning control for maximum output indication. The frequency read on the Amplifier FREQUENCY dial should agree with the signal generator dial within ±10%.

NOTE

For closer checks, a frequency counter may be connected to the signal generator.

2.1.3.4 Bandwidth Check.

a. Use test setup shown in Fig. 2-1.

b. Set signal generator frequency to

TABLE 2-1 TEST FREQUENCIES (MHz)

11	37	130
14	50	180
18	60	230
20	70	280
26	90	380
33	120	450

11 MHz CW and output level to approximately 50 millivolts RMS.

c. Set the Amplifier METER RANGE selector to HI, and set the band selector to the proper band.

d. Adjust the vernier tuning control for maximum output indication; then set the generator output level for exactly 10 volts at the Amplifier output as read on the Amplifier meter.

e. While observing the output meter on the signal generator to ensure constant Amplifier input level, vary the signal generator frequency first one way and then the other to determine the high and low frequencies at which the output of the Amplifier falls to 7.1 volts. These are the 3 db points. The frequency spread between these two frequencies is the 3 db bandwidth. The bandwidth for frequencies below 150 MHz should be at least 1.5 MHz. Above 150 MHz, the 3 db bandwidth should be at least 3.0 MHz.

f. Repeat steps b through e for other desired test frequencies.

2.1.3.5 Gain Check.

a. Connect equipment as shown in

Fig. 2-1.

b. Set RF voltmeter to the 1 volt full scale range. Set Amplifier METER RANGE Selector to HI.

c. Set signal generator to 11 MHz with a CW output. Adjust Amplifier to that frequency, and peak for maximum output. Adjust signal generator level for a 1 volt rms indication on the RF voltmeter. (This corresponds to 10 volts into 50 ohms).

d. Disconnect signal generator from Amplifier and 20 db attenuator from the RF-815 Amplifier.

e. Connect signal generator to 20 db attenuator, and record voltage level.

f. The gain of the Amplifier is found by calculating the algebraic difference between the Amplifier output and the signal generator output levels. The gain should be at least 34 db.

g. The complete procedure above may be repeated for other frequencies if desired.

2.1.3.6 Output Level Accuracy.

a. Use the test setup shown in Fig. 2-1.

b. Set RF voltmeter to 0.1 volt full scale range. Set Amplifier METER RANGE selector to LO.

c. Set Signal Generator to 10 MHz with a CW output. Adjust the Amplifier to that frequency, and peak for maximum output. Adjust Signal Generator level for a 0.1 volt RMS indication on the RF Voltmeter. (This corresponds to 1.0 volt RMS across 50 ohms.)

NOTE

It is essential to the outcome of this test that an accurate RF Voltmeter and associated tee probe adapter is used. It is also important that the cumulative VSWR of the RF termination, the 20 db pad, the RF Voltmeter tee probe adapter with probe installed, and all associated cabling and coaxial adapters is as low as possible.

d. With the Signal Generator adjusted for a 0.1 volt reading on the RF Voltmeter, the Amplifier output meter should read 1.0 volt $\pm$ 1.5 db.

e. Repeat (c) through (d) at voltage levels of 0.3 VRMS and 0.5 VRMS on the

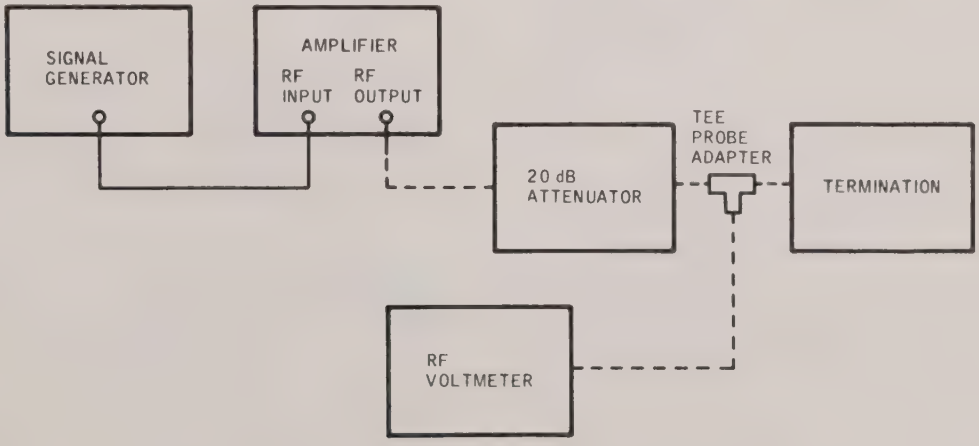


Figure 2-1. RF-815 Amplifier Test Setup

RF Voltmeter while checking for corresponding readings on the Amplifier OUTPUT METER of 3.0 VRMS and 5.0 VRMS.

f. Switch METER RANGE selector to HI.

g. Repeat (c) through (d) at RF Voltmeter levels of 0.5, 1.0, and 1.5 VRMS. The Amplifier OUTPUT METER readings should be 5.0, 10.0, and 15.0 VRMS, respectively within $\pm$ 1.5 db.

h. Repeat (a) through (h) at 100 MHz and 480 MHz.

2.2 PREPARATION FOR USE.

2.2.1 POWER REQUIREMENTS.

The RF-815 Amplifier requires a power source of 115 or 230 volts AC $\pm$ 10%, 50/60 Hz, single-phase, which can supply up to 150 watts.

The two position slide switch mounted on the rear panel permits operation from either a 115 or 230 power source. The screwdriver slot in the slider must be pushed toward the 115 or 230 volt label depending upon the line voltage to be used.

Adjacent to the line voltage labelling is marked the correct fuse rating for each line voltage. The fuses are of the slow-blow type and 3AG size. Check to be sure that a fuse of the correct rating is installed.

CAUTION

To avoid damage to this instrument set the 115/230 volt slide switch for the line voltage to be used before connecting the power cable to the power source.

2.2.2 POWER CABLE GROUND PROTECTION.

To protect operating personnel, the RF-815 Amplifier is equipped with a three conductor power cable and plug which, when inserted in an appropriate receptacle, grounds the panel and cabinet. The round offset pin on the power cable three-prong connector is the ground pin.

To preserve the protection feature when operating the instrument from a two contact outlet, use a three-prong adapter and connect the green pigtail on the adapter to ground.

2.2.3 COOLING.

When the Amplifier is either cabinet or rack mounted, provisions must be made so that there is adequate clearance around the instrument to allow air circulation. The RF-815 is forced air cooled, and the inlet air location is on its rear panel. The exhaust air from the instrument exits through perforations located on both side covers of the cabinet. Ambient temperature must not exceed 50^{o}C (122^{o}F).

2.3 MOUNTING.

The RF-815 is normally set on a bench during operation. If a metal bail is provided under the cabinet it may be locked down into position if desired to tilt the front panel upward toward the operator.

The Amplifier may be rack mounted, using the rack mount kit described in paragraph 1.4. Chassis slides are also available as a separate kit.

To install the rack mount panel extensions, remove the two screws from each handle assembly on the front panel. Re-install with the panel extensions between the front panel and the handle spacers. When installed in a cabinet, some support should be provided under the Amplifier so that it is not cantilevered from the front panel extensions.

If chassis slides are to be used in addition to panel extensions, install them as follows.

a. Refer to figure 2-2A, and remove section (C) from the left hand slide by pushing spring lever (D) upward and pulling slide section (C) out of section (B).

b. Mount section (C) to left side of chassis with two No. 10 pan head screws as shown in figure 2-2B. Make sure that the corner cutout on section (C) is oriented toward the top of the chassis as shown.

c. Repeat steps a and b for the right-hand chassis slide section (C).

d. Determine the exact locations for mounting the remaining parts of the slides to the cabinet frame. (See figure 2-2C).

NOTE

Sections (A) and (B) are inseparable.

e. After making sure that the correct slide sections are identified for the left and right-hand sides, fasten fixed bracket (E) to the front cabinet rail.

f. Assemble but do not tighten adjustable bracket (H) to the rear of section (A) with two No. 10 screws (G) and one of the nut plates (F) supplied.

g. Secure adjustable bracket to rear vertical cabinet rail; then tighten screws (G).

h. Repeat steps e through g for the other slide sections (A) and (B).

i. Pick up RF-815; insert rear of chassis mounted slide sections (C) into cabinet slide sections (B); and pull up spring levers (D) to allow full collapse of slides into cabinet.

NOTE

Latches between locking sections (A) and (B) will automatically unlock as section (C) is fully inserted. Spring lever (D) is the only locking device which requires manual release.

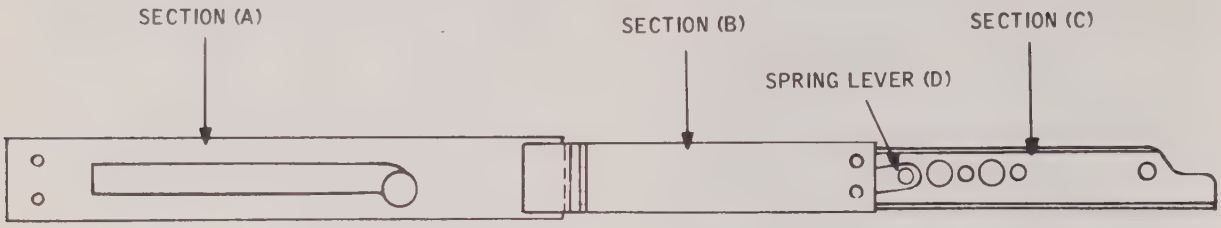
2.4 PACKAGING FOR RESHIPMENT.

Whenever possible, the original shipping carton and packing material should be used for reshipment. If the original packing material is not available, wrap the instrument in heavy paper or plastic. Use a strong shipping container. A carton made of at least 400 lb. test material will usually provide adequate protection. Use at least 2 inches of shock absorbing material around all sides of the instrument to provide a firm cushion and to prevent movement inside the container. Protect the front panel by means of cardboard or other material which will not scratch the meter face or front panel. Close the carton securely and seal with durable shipping tape.

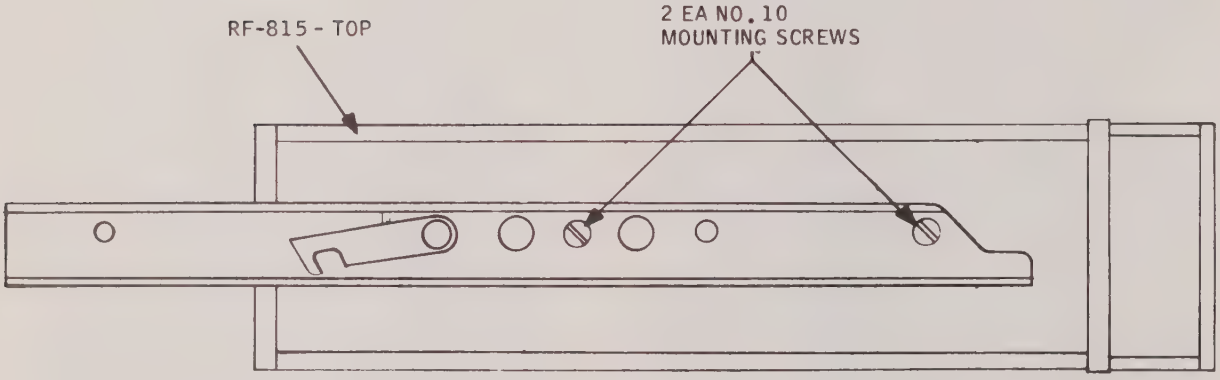
CAUTION

Mark the shipping container FRAGILE to assure careful handling.

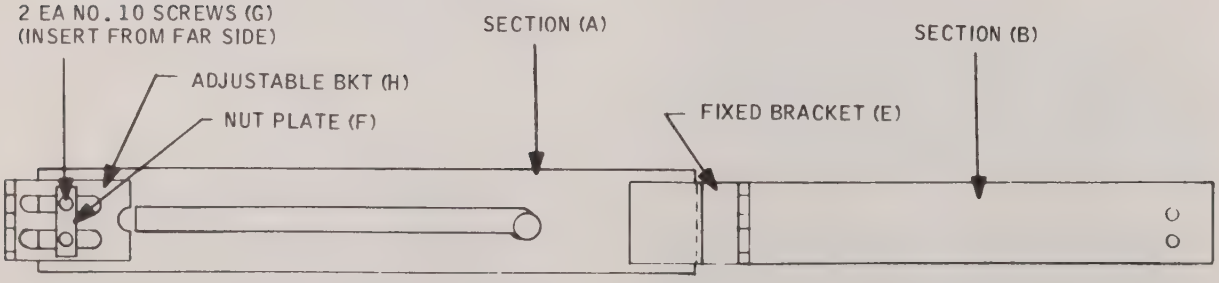
In correspondence relative to this instrument, be sure to refer to the model number and serial number.



A. LEFT-HAND SLIDE SHOWN FULLY EXTENDED.



B. SLIDE SECTION (C) MOUNTED ON LEFT SIDE OF RF-815.



C. LEFT-HAND SLIDE ATTACHMENT TO RACK.

Figure 2-2. Chassis Slide Rack Mount Kit Assembly and Installation

CHAPTER 3
OPERATION

3.1 FUNCTIONAL DESCRIPTION.

The RF-815 Amplifier is used to increase the available power from common signal generators in the 10 to 500 MHz range to a level of up to 4.5 watts peak power. It can be used with any form of modulated signal within its bandwidth limits (paragraph 1.3) or with CW signals. The noise figure of the Amplifier is very low, typically 10 db. The RF-815 is designed for use with 50 ohm input and output devices. Tuning consists of simple band selection and tuning for maximum output. The Amplifier is a laboratory instrument which is protected from overdrive harm or operation with high VSWR loads.

Less than 1 volt is required from the signal generator to drive the Amplifier to full output of 4.5 watts peak envelope power. The output level obtainable is limited only by the peak of the signal amplitude. The Amplifier can deliver up to 4.5 watts continuously into a 50 ohm load with a CW input signal.

The output meter responds to rf voltage at the Amplifier output. It is calibrated to read RMS values for a CW sine-wave signal. For convenience it is also calibrated to show equivalent rf power into a 50-ohm load. Amplitude modulation of the signal may cause the meter reading to be higher than the average RMS signal, and this fact should be considered when interpreting readings. A 15-volt carrier 100% modulated at 100 Hz will cause distortion due to excessive peak swings even though the meter will not read much higher than 15 volts.

NOTE

1. Instantaneous rf levels causing a meter reading corresponding to approximately 120% of the full scale voltage of the meter (depending on the position of the METER RANGE selector) will trip the overdrive protection circuits. Pulsed signals or amplitude modulated (or SSB) signals can exceed this level, causing distortion, even though the output meter indicates an average level in the normal operating range.

2. Any amplifier will oscillate if some of the output signal is allowed to return to the input at sufficient amplitude and phase. Use of this unit must include electronic isolation of the output signal and load from the signal source.

3. The output metering circuit indicates the level at the output of the power amplifier stage. There is a short length of cable, (approximately 11 inches) between this point and the RF output connector on the front panel, and there will generally be some length of cable between the Amplifier and the load. When operating with other than a 50 ohm resistive load, a voltage standing wave along these cables can create an overdrive condition which may not be apparent from a

meter connected at the load. However, the internal protection circuit senses such a condition and automatically cuts back the gain of the Amplifier and illuminates the OVERDRIVE indicator. Also, with a high VSWR load, the two meters, one at the load and one in the Amplifier, may not agree since they are measuring different voltages.

3.2 CONTROLS, INDICATORS, AND CONNECTORS.

Following is a brief description of each of the devices on the RF-815 with which the operator might be concerned.

POWER Switch (front panel) - Depressing the ON side of the rocker arm turns the instrument on. The rocker arm illuminates when power is on.

RF INPUT and RF OUTPUT Connectors (front panel) - Type "N" connectors for the driving source and output load, respectively.

METER RANGE Selector and Meter (front panel) - Two ranges available to indicate rf output voltage: LO, 0 - 5 volts rms, and HI, 0 - 20 volts rms. For convenience, corresponding calibrations are marked on the meter scale for power into a 50 ohm resistive load impedance. METER RANGE Selector also determines overdrive trip level.

OVERDRIVE Indicator (front panel) - Illuminates to indicate that drive level is exceeding that necessary for approximately 120% of the full scale output meter voltage. The trip level depends on the setting of the METER RANGE selector and corresponds to approximately 6 volts rms output on the LO position and 24 volts rms output on the HI position. The gain of the Amplifier is reduced to limit the output when this indicator is lit. The operator should reduce the drive when this occurs to reduce distortion of the output signal.

Band Selector and Vernier Tuning Control (front panel) - These controls are used to change operating bands and to tune the output network in the last power amplifier stage to resonance. Tuning is a simple process of peaking the two-speed vernier tuning control for maximum output indication. Loading is established in the design of the output network for a presumed load impedance of 50 ohms. A slide-rule type FREQUENCY dial indicates actual resonant frequency.

Fuseholder - Contains a 3AG, slow-blow fuse for primary power protection. Values for 115 and 230 volts are marked on the rear panel next to the 115V/230V power line selector switch.

115V/230V Selector (rear panel) - Slide switch operated by using flat screwdriver blade as a key to select proper power supply connections for the intended line voltage.

Line Cord (rear panel) - Three prong type plug with safety ground pin connected to cabinet. Use grounding plug adapter for operation with other than proper receptacle.

Air Filter (rear panel) - Removes dust and particles from input air and covers blower fan. Requires periodical cleaning (See paragraph 5.3)

3.3 OPERATING PROCEDURES.

a. Set the 115V/230V switch to the position corresponding to the line voltage to be used.

b. Check that the rating of the fuse installed is appropriate for the line voltage used.

c. Connect the load to be driven to the RF OUTPUT connector on the amplifier front panel.

d. Set the METER RANGE Selector to the desired position.

e. Check that the signal source is set to the desired frequency and that the output is set to minimum.

f. Connect the signal source to the RF INPUT connector on the front of the Amplifier.

g. Set the Amplifier band selector and vernier tuning control for the desired operating frequency according to the FREQUENCY dial.

h. Turn on the POWER switch. The lamp within the switch housing should illuminate. A period of 30 seconds should be allowed from initial turn on to allow filament heating in the final stage tube.

i. Increase the signal source level until a small indication on the amplifier output meter can be seen. Peak the vernier tuning control for maximum output indication.

j. Adjust the level of the signal source for the desired output level.

3.4 LOAD MISMATCH.

The RF-815 was designed for use in 50 ohm systems. A tuned amplifier, such as the RF-815, cannot maintain a constant output impedance without a complex method of controlling both output coupling and tank circuit reactance or allowing for the insertion loss of a broadband matching pad. Where the application requires, the RF-815 Amplifier output impedance may be matched to the load through external matching networks, pads, or stub tuners, depending on power gain requirements and operating frequency.

3.5 OVERDRIVE PROTECTION.

The overdrive circuit in the RF-815 has been designed to aid the operator with a warning indication, while providing protection for the instrument. As explained elsewhere, the indicator lamp on the front panel will illuminate when either of the two meter ranges is exceeded by approximately 20%. Should this occur during operation on the LO (0 - 5 VRMS) range of the output voltage meter, the operator is warned that the output voltage at the final amplifier has exceeded 5 volts. Appropriate action should be taken which will consist of either switching to the HI (0 - 20 VRMS) range or reducing the drive level. Should the lamp illuminate when the meter range switch is at the HI position, the drive must be reduced. It must be remembered that the overdrive circuit lamp will illuminate and limiting action will occur within the amplifier when either meter scale is over-ranged. Signal amplitude information may be lost due to compression and the equipment may be damaged during extended operation under this condition.

CHAPTER 4
PRINCIPLES OF OPERATION

4.1 FUNCTIONAL BREAKDOWN.

The RF-815 is divided functionally as follows. The Output Amplifier Assembly (designated A1) houses the output amplifier stage (A1V1), turret assembly (A1A1), and output detector assembly (A1A2). This assembly is mounted on the center of the chassis and is cooled by forced air from the rear of the unit. The Preamp Assembly (designated A2) consists of five stages of broadband transistor rf amplifiers and associated bias circuitry constructed on a printed circuit board. The Preamp Assembly is mounted inside a shield cover on the left side of the chassis. Most of the remaining circuits are power supply and overdrive protection circuits which are constructed on a printed circuit board on the right side of the chassis. This assembly is called the Power Supply Assembly (designated A3). Miscellaneous controls, indicators, connectors, and other parts which are mounted directly on the main frame (chassis and panels) are not a part of any assembly and therefore their reference designators are not prefixed with an assembly designator. Parts mounted on an assembly are identified by reference designators prefixed by their assembly designation, e.g. A3R17.

4.2 CIRCUIT DESCRIPTIONS.

Refer to functional block diagram, figure 4-1. The rf input signal is amplified successively by five broadband transistor stages in the A2 Preamp Assembly to a level sufficient to drive the output amplifier tube in the A1 Output Amplifier Assembly. The five transistor rf stages operate in Class A. Additional transistors are used for each stage to provide stiff control of the bias for the rf amplifier transistors. The first two rf stages, which normally run at full gain, have the capability of approximately 20 db of agc (automatic gain control), which takes effect only if an overdrive condition exists. The following two stages are similar single transistor stages, but they have no agc. The fifth stage, consists of a hybrid-coupled pair of transistors. Untuned broadband coupling networks are used between the transistor rf stages and between the driver stage and the output amplifier stage in the A1 Output Amplifier Assembly.

The output amplifier stage in the A1 Assembly consists of a single 2C39A triode tube operating as a class AB grounded-grid amplifier. The input to the cathode is untuned; the output is tuned and transformed to the 50 ohm output impedance by a turret-selected wideband tuned transformer. The band selector on the front panel rotates the A1A1 Turret Assembly to select one of the six tuned transformers. The two-speed front panel vernier tuning control adjusts the positions of pistons in two tuning capacitors which resonate the plate winding of the selected transformer. Some of the rf at the secondary of the output transformer is rectified by an output detector, and the resultant dc output is applied to the metering circuit.

The dc signal from the detector is fed through the METER RANGE selector and one of two selected meter adjustment potentiometers to the output meter. The

other side of the meter returns to ground through a base resistor in the first of two dc amplifiers in the overdrive protection section of the A3 Power Supply Assembly. This arrangement allows overdrive sensing to be based on the selected range of the meter. The OVERDRIVE lamp illuminates when the meter current reaches approximately 120 microamperes, corresponding to 120% of the full scale voltage indication of the meter (about 6 volts for the 5 volt range or about 24 volts for the 20 volt range). Agc to reduce the gain of the Amplifier takes effect at a level slightly higher than required to illuminate the OVERDRIVE indicator to provide a type of "advance notice". The dc signal from the meter is amplified by two successive dc amplifiers, and the resultant signal is used to turn on both the overdrive indicator switch transistor and the agc switch transistor when their respective threshold levels are exceeded. The overdrive indicator switch saturates quite rapidly as its threshold is exceeded; but the agc switch output varies as necessary with the input signal, after its threshold is reached, to hold the rf output of the Amplifier at the required limit. The output of the agc switch is applied to the bias/agc amplifiers in the A2 Preamp Assembly to control the gain of the first pair of rf amplifier transistors.

The power supply section of the A3 Power Supply Assembly consists of two regulated dc power supplies and a filament supply. The regulated dc supplies provide 20 VDC power for the transistor circuit and 350 VDC for the plate of the 2C39A tube. Primary power for the power transformer is supplied through a line filter and a fuse, the POWER on/off switch, and a 115V/230V switch to the split primary of the transformer.

Refer to schematic diagram, Figure 6-1, for the following discussion of the voltage regulators on the A3 Power Supply Assembly. The low voltage dc supply consists of a full wave bridge rectifier and a capacitive filter, followed by an integrated circuit voltage and current regulator which drives a series pass transistor. Integrated circuit IC1 consists of a temperature compensated reference amplifier, a voltage error comparator, a series pass transistor, and current limiting circuitry. Additional ripple rejection is obtained as a by-product of the voltage error comparator. The integrated circuit is used in conjunction with an external pass transistor to increase the current capability. Inputs at pins 1 and 10 of A3IC1 provide current sensing information, derived from the voltage drop across A3R18, to a current limiter. An output voltage sample taken from voltage adjust potentiometer A3R20 is fed through pin 2 to one input port of the internal voltage comparator, and the jumper between pins 3 and 4 provides a connection from an internal voltage reference to the other input port of the voltage comparator. The output from pin 6 of A3IC1 is a composite from the voltage and current regulating circuitry. It is applied to the base of Q5 to regulate the output appearing at the junction of A3R18 - A3R19.

The high voltage dc supply consists of a full wave bridge rectifier and a capacitive filter, followed by two sets of darlington pass transistors which are connected in series to obtain the required voltage rating. The regulating action is a function of the current drawn through the base bias circuits of transistors Q2 and Q4 by transistors A3Q1 and A3Q2. Current regulator transistor A3Q2 is effectively controlled by the current drawn through A3R7, since its base voltage is supplied indirectly from the supply side of A3R7, and its emitter is connected to the load side of the supply. Potentiometer A3R10

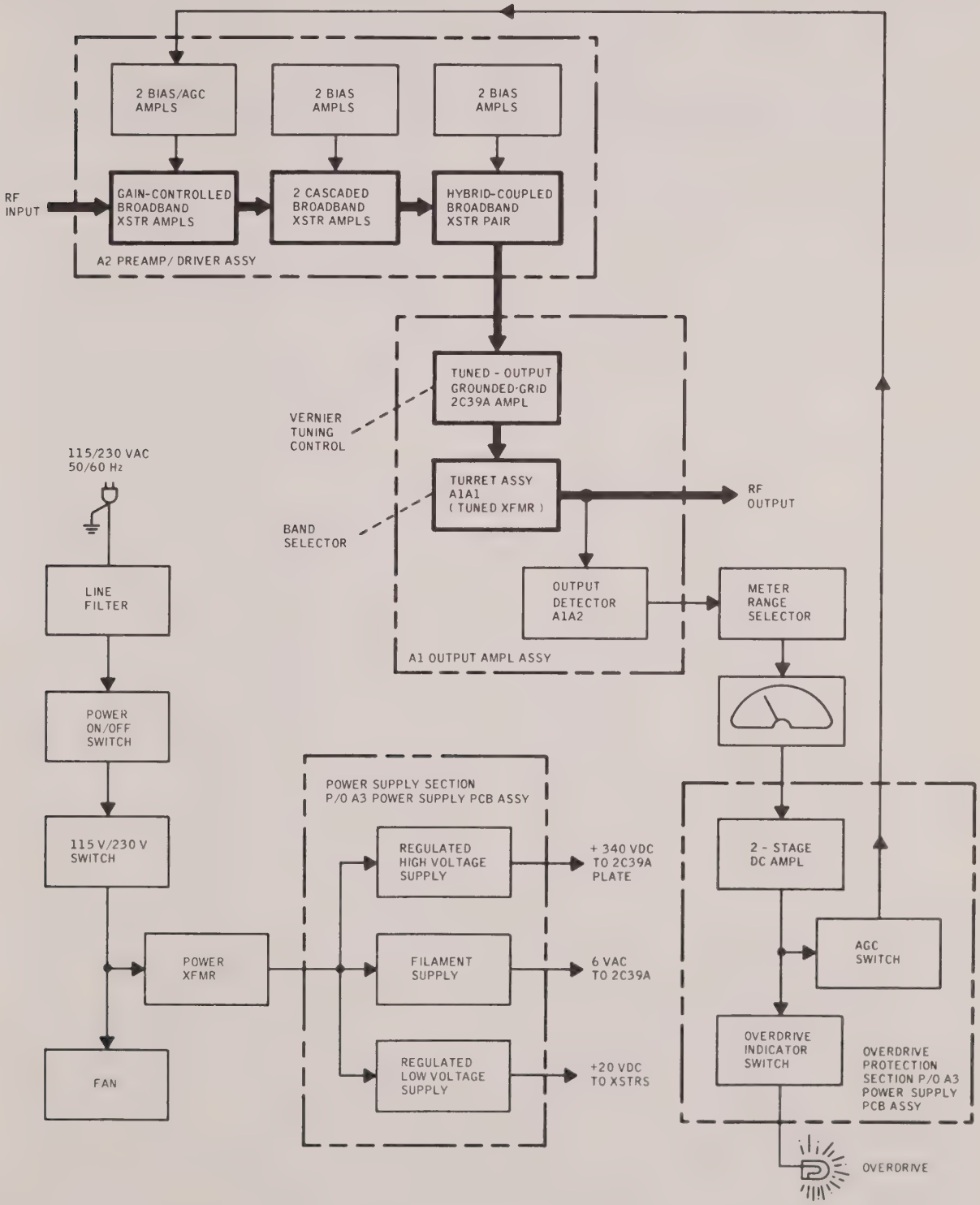


Figure 4-1. RF-815 Amplifier Functional Block Diagram

sets the current level at which A3Q2 begins to conduct. Voltage regulator transistor A3Q1 is driven by A3Q3, which conducts as a function of power supply voltage. The emitter of comparator A3Q3 is clamped to the output of the supply through A3VR1, and the base of A3Q3 is connected to a voltage divider which returns to ground. Potentiometer A3R12 sets the regulation voltage. As the output of the regulated supply attempts to decrease in voltage, A3Q3 draws more current through A3R8; and A3Q1 thereby draws less current through A3R1 and A3R4 to increase conduction in the pass transistors and thus maintain the output voltage. The reverse is also true. If the output of the regulated supply attempts to increase, A3Q3 and A3Q1 will make the pass transistors conduct less to maintain the output voltage. Capacitors C4 and C5 prevent high frequency oscillations.

CHAPTER 5
MAINTENANCE AND CALIBRATION

5.1 GENERAL.

All subassemblies are easily accessible for maintenance and repair. The top bottom, and side covers may be removed for access by removing the screws fastening them to the rear panel and pulling straight back. Figures 5-1 through 5-6 identify major components.

The RF-815 is aligned at the factory; and in general, it should not require realignment except after repair or replacement of a subassembly. A performance test is given in paragraph 2.1.3 as a quick method of determining whether the Amplifier meets its specifications. This is a handy method of determining if repair is required. If there is any evidence of malfunction, refer to troubleshooting information in paragraph 5.9.

The only periodic maintenance required is air filter cleaning and lubrication of the fan motor. These items are described in paragraphs 5.3 and 5.4. The remaining portion of this chapter pertains to adjustment, alignment, and special repair procedures.

5.2 TEST EQUIPMENT REQUIRED.

The following test equipment or suitable equivalents are recommended for servicing:

Rf Signal Generator, H-P 608E, 10 to 480 MHz, frequency calibration ± 1%.

Rf termination, 50 ohms, General Radio W-50B.

Volt-Ohm - Milliammeter, Simpson 260.

Rf Voltmeter, HP 3406A with 11063A Tee Probe Adapter.

Rf Attenuator, 20db, General Radio 874-620.

Wire-Wound Load Resistor, 2800 ohm ± 5%, 50 watt dissipation.

5.3 AIR FILTER CLEANING.

The air filter on the rear panel should be visually checked every few weeks and cleaned if dirty. More frequent inspections and cleanings are required under severe operating conditions. To remove the filter, loosen the two captive air filter retaining screws, and pull straight back.

To clean the filter, place it under a water faucet, flush the dirt from its screening, and let dry.

5.4 FAN LUBRICATION.

The fan motor bearings should be lubricated every three or four months with a few drops of SAE No. 20 non-detergent oil. There are two holes, one next to each of the bearings, through which oil can be applied to felt reservoir pads. Top, bottom, and side covers must be removed from the amplifier and the rear panel must be disassembled from the side rails. Remove all covers by removing the screws attaching them to the rear panel and pulling each straight

back. The top and bottom covers must be removed before the side covers.

Remove the eight (8) screws fastening the rear panel (two at each corner), and gently rotate the rear panel back approximately 45° taking care not to break the line power cabling. The front bearing of the fan motor will now be accessible for lubrication.

Reassemble the rear panel to the side rails and the covers to the unit. The side covers must be attached first and the top and bottom covers last.

Remove the air filter as described in para. 5.3 to expose the rear fan motor bearing. Replace the air filter after fan lubrication.

5.5 LOW VOLTAGE POWER SUPPLY ADJUSTMENT.

The 20 VDC regulated power supply for the transistor circuits has a voltage adjustment potentiometer (A3R20) which requires adjustment if the power supply circuit has been repaired. The current limiting function of this power supply requires no adjustment. Following is a procedure for adjusting A3R20.

a. Rotate potentiometer A3R20 fully counterclockwise by inserting the insulated tool provided through the "LV adj" hole in the Power Supply PCB assembly cover. (See figure 5-1.)

b. Connect AC line cord.

c. Connect VOM test leads to A3R29 (positive lead) and A3E1 (negative lead). (See figure 5-6.)

d. Turn unit on, and adjust A3R20 for an indication of 20.0 volts on the VOM.

e. Turn unit off, and remove VOM test leads.

5.6 HIGH VOLTAGE POWER SUPPLY ADJUSTMENTS.

5.6.1 GENERAL.

The 350 VDC regulated power supply for the plate circuit of the 2C39A tube has a voltage adjust potentiometer (A3R12) and a current limit adjust potentiometer (A3R10). Following are procedures for making these adjustments.

WARNING

AC and DC high voltages exist in the A3 Power Supply Assembly area. Use appropriate precautions when working in this area. Adjustments should be made with the insulated tool provided. Be especially careful to avoid dropping tools or hardware into this area. It is strongly recommended that the line cord be disconnected whenever possible when working on these circuits.

5.6.2 VOLTAGE REGULATION ADJUSTMENT.

a. Turn off POWER switch, and unplug line cord.

b. Remove top cover.

c. Rotate potentiometer A3R12 fully clockwise by inserting the insulated tool provided through the "HV adj" hole in the Power Supply PCB assembly cover. (See figure 5-1.)

d. Connect a VOM to A3E8 (positive lead) and A3E1 (negative lead). (See figure 5-6.)

e. Plug the line cord into an appropriate source of power, and allow 30 seconds for the output tube to warm up

f. Adjust A3R12 for +350 vdc on the VOM.

g. Turn off power, and disconnect line cord.

h. Disconnect VOM; and either replace covers, or proceed with current adjustment.

5.6.3 CURRENT REGULATION ADJUSTMENT.

NOTE

A load resistor will be required for this adjustment which can dissipate at least 50 watts and which is rated at 2800 ohms ± 5%.

a. Disconnect line cord.

b. Remove top cover.

c. Rotate potentiometer A3R10 fully counterclockwise by inserting the insulated tool provided through the "HV current limit" hole in the Power Supply PCB assembly cover. (See figure 5-1.)

d. Disconnect A1V1 plate supply lead from A3E8 on the PC Board. (See figure 5-6.)

e. Connect 2800 ohm resistor to A3E8 and A3E1 (or other suitable ground point).

CAUTION

Be sure that the test leads and resistor do not touch any other circuits or metal parts and that the resistor cannot be shorted accidentally. The load resistor and associated wiring will have +350 vdc applied to them.

f. Connect VOM across the load resistor.

g. Plug the line cord into a suitable source of power, and turn on the POWER switch. The VOM should indicate +350 vdc. If not, adjust voltage adjust potentiometer A3R12 for the correct voltage.

h. Advance current adjust potentiometer clockwise until the voltage on the VOM drops 5 volts to approximately +345 vdc.

i. Turn off POWER switch, and disconnect line cord.

j. Remove 2800 ohm resistor and test leads, and reconnect A1V1 plate supply lead to A3E8.

k. Replace top cover.

5.7 RF ALIGNMENT.

The only rf alignment required is that of the output networks in the A1 Output Amplifier Assembly. The adjustments consist of a tuning slug in the transformer for each of the five low frequency bands and two tracked piston capacitors which are common to all bands. Alignment adjustments must be done accurately to track the tuned circuits with the FREQUENCY dial on the front panel and to obtain optimum gain at all frequencies. Alignment should be done only when necessitated by repair of the assembly or tube replacement, and then it should be done carefully according to the following procedure using the insulated tool provided.

5.7.1 250-500 MHZ ALIGNMENT.

The following adjustments will correctly position the piston trimmers A1C4 and A1C5. No further adjustment is necessary for this frequency band.

a. Remove the top cover and screws from the A1 Amplifier Assy.

b. Rotate the front panel vernier tuning control fully clockwise.

c. Observe the piston of capacitor A1C4, the top most of the two piston

trimmers. Adjust it so that it protrudes beyond the metalized ground area of the glass tube approximately 1/32 inch. (See figure 5-2.)

d. Rotate the front panel vernier tuning control fully counterclockwise.

e. Observe the piston of capacitor A1C5, the lower of the two piston trimmers. The piston end should be approximately 1/32 inch inside the top or open end of the glass tube.

f. Replace the cover and screen on the A1 Amplifier Assembly.

g. Connect the amplifier and test equipment as shown in figure 2-1. Adjust the Signal Generator to a frequency of 475 MHz and an output level of approximately 100 millivolts. Select the 250-500 MHz band using the band selector. Adjust the vernier tuning control so that the pointer aligns with the 475 MHz mark on the FREQUENCY dial.

h. With the output voltage METER RANGE switch in the HI position, adjust A1C5 for a maximum reading on the RF Voltmeter.

i. Adjust the Signal Generator frequency to 250 MHz and level to approximately 100 millivolts. Rotate the Amplifier vernier tuning control so that the pointer aligns with the 250 MHz mark on the FREQUENCY dial.

j. Adjust piston trimmer A1C4 for a maximum reading on the RF Voltmeter.

k. Check FREQUENCY dial accuracy at other points in this band using the procedure detailed in paragraph 2.1.3.3.

l. Apply a small amount of adhesive material such as Pliobond or Q-dope to the piston capacitor adjustment screws so that bench handling, transit shocks etc. do not change the settings.

5.7.2 125-250 MHZ ALIGNMENT.

a. Connect equipment as shown in figure 2-1.

b. Remove top cover and screen of A1 Amplifier Assy. This will provide access to the 5 turret tuning cores.

NOTE

To adjust a given transformer core, rotate the Bandswitch from the desired operating band to the next lower frequency band. This will provide access to the tuned transformer to be adjusted.

c. Return turret to appropriate band to verify adjustment effect.

WARNING

The Amplifier will be on during this alignment procedure. Therefore the tube plate, the turret, and many associated components will be at a DC potential of +350 volts. Use insulated tool provided for all adjustments.

d. Adjust Signal Generator for a frequency of 175 MHz and an output level of 50 millivolts.

e. Set the RF-815 band selector for the 125 to 250 MHz band, and adjust the vernier tuning control for exactly 175 MHz as indicated by the FREQUENCY Dial.

f. Adjust the transformer core until the Amplifier tuning peak occurs at 175 MHz.

g. Check FREQUENCY dial accuracy at the band edges as described in para-

graph 2.1.3.3.

5.7.3 ALIGNMENT OF REMAINING BANDS.

a. Align the transformers of the remaining frequency bands, using the method described above. For each band select a frequency near the band center to peak the output level.

b. Replace the top cover and screen of the A1 Amplifier Assy.

5.8 METER CALIBRATION.

The output meter of the RF-815 Amplifier indicates the voltage present at the output of the A1 Amplifier Assy. When performing the following test, it is important that the signal used be free of impressed amplitude modulation, and as explained in paragraph 2.1.3.6 the output line VSWR must be maintained at a minimum.

a. Connect equipment as shown in figure 2-1.

b. Adjust Signal Generator for a frequency of 100 MHz and an output of approximately 50 millivolts.

c. Set band selector to 65-125 MHz range, and set vernier tuning dial for maximum indication on Rf Voltmeter.

d. Set METER RANGE Selector to LO. Adjust the Signal Generator attenuator for an indication of 0.5 volts on the RF Voltmeter.

e. Note the Output Meter indication. Adjust A3R23 for an indication of 5.0 volts rms by inserting the insulated tool provided through the "0-5 Meter Adj" hole in the Power Supply PCB assembly cover. (See figure 5-1.)

f. Switch METER RANGE Selector to HI, and adjust the Signal Generator for an indication of 1.5 volts rms on the RF Voltmeter.

g. Observing the Output Meter, adjust A3R24 for an indication of 15.0 volts rms by inserting the insulated tool through the "0-20 Meter Adj" hole. (See figure 5-1.)

h. Repeat the Output Meter accuracy test described in paragraph 2.1.3.6, and re-adjust A3R23 and A3R24 as required to obtain the necessary overall accuracy.

5.9 TROUBLESHOOTING.

The first step in isolating a trouble is to review the conditions under which the symptoms were observed and check that the trouble was not caused by the external test equipment and load connections or by associated equipment used in the setup. Observe the front panel output meter, OVERDRIVE indicator, POWER switch, and fuse, and check the positions of the Band Selector and FREQUENCY dial indicator. Note any details which might help to locate the trouble.

Some commonly found symptoms, together with notes as to possible cause and recommendation, are listed in Troubleshooting Guide, table 5-1. Also, take advantage of dc voltages and signal levels marked on schematic diagram, figure 6-1, to check operating points and signal levels of the suspected stages.

5.10 TUBE REPLACEMENT.

a. Remove top cover of the RF-815 Amplifier.

b. Remove the top cover of the A1 Amplifier Assembly.

c. Referring to figure 5-1, loosen the plate and grid ring clamps.

d. Slide the plate ring clamp to the right (as viewed facing the front of the Amplifier) until it is free of the tube. Set it aside.

e. Move the 2C39A toward the right of the Amplifier unit while moving the cathode and filament connectors toward the left of Amplifier unit until they disengage.

f. Remove 2C39A tube.

g. To replace 2C39A, reverse the above procedure being careful to properly position the plate contact strap. See figure 5-2.

5.11 SPECIAL REPAIR PROCEDURES.

The following paragraphs detail procedures for repair/replacement of certain RF-815 components.

5.11.1 DETECTOR REPAIR.

a. Remove A1 Amplifier Assembly top cover and screen.

b. Unsolder Detector output lead at A1E4. Straighten wire end, and remove excess solder. (See figure 5-2.)

c. Carefully unsolder the lead of A1A2CR2 from the center conductor pin of A1J2.

d. Remove A1A2 Detector Assembly by loosening the 4-40 screw fastening it to the A1 Amplifier Assembly wall. See figure 5-1.

e. The A1A2 Detector Assembly is not field repairable. If a unit is faulty, order a replacement from R F Communications.

5.11.2 LUBRICATION.

After performing repairs it may be necessary to lubricate the turret contacts The turret contacts should be coated with a small amount of Dow Corning 103 Silicone Compound.

In addition to the above it may be necessary to relubricate the tuning mechanism thrust bearing and panel bushing that supports the band switch shaft, using Aero Lubriplate lubricant. The lead screw and nut assembly does not require lubrication.

5.11.3 TURRET REPLACEMENT.

a. Remove front panel vernier tuning control and bandswitch knobs.

b. Remove front panel by removing the four corner screws from the side rails.

c. Remove the A2 Preamp Assembly by loosening and removing the four hold-down screws and removing all associated cabling. Remove left side cover of unit.

d. Remove the bandswitch gear assembly by removing the four screws securing it to the A1 Amplifier Assembly.

e. Remove the spring clip from the right end of the turret shaft.

f. Loosen the two turret mounting set screws. Pull the shaft slowly through the A1 Assembly towards the left until the A1A1 Turret can be removed from the shaft.

g. Place the new turret onto the shaft being careful to orient it correctly so that the contact pins are in proper position to mate with the A1 Amplifier Assembly Contact Springs.

h. Re-assemble the unit following the above procedure in reverse.

i. It will be necessary to align the turret transformers of the five lowest frequency bands. It may also be necessary to re-align the piston trimmers. Refer to paragraph 5.7, RF Alignment, for detailed information.

Table 5-1 TROUBLESHOOTING GUIDE.

SYMPTOM	POSSIBLE CAUSE	RECOMMENDATION
Blown Fuse	Wrong Fuse Value	Check fuse value to verify correct rating for line voltage.
	Defective A3 Power Supply PCB or frayed harness wire.	Remove unit top cover and visually inspect unit. To isolate possible A3 defect, remove T1 transformer wires from A3E2 through A3E7.
Low RF Gain	Incorrect A3 Power Supply PCB adjustments	Check +20vdc Regulator. See paragraph 5.5. Check +350vdc Regulator. See paragraph 5.6.
	Dirty or incorrectly adjusted A1 Amplifier Ass'y Contacts.	Remove A1 Amplifier Ass'y cover and inspect for dirt and bent or poorly adjusted contacts. Clean and adjust as required.
Low RF Gain	Band Selector or A1A1 Turret Ass'y incorrectly adjusted.	Verify proper mechanical alignment.
	A2 Preamplifier Defective	To verify correct operation, disconnect A2P1 from A1J1 and connect A2P1 to 20 db attenuator as in figure 2-1. Check for at least 3vrms (measure .3vrms on RF Voltmeter) output. Check DC voltages shown on schematic diagram 6-1 to isolate fault.
	115/230 Volt line switch in the wrong position	Check for correct position of line switch.
	Internal coaxial cables not connected	Check for proper cable connector mating. Check cable connector center pins to insure full insertion into jacks A1J1 and A1J2.

Table 5-1 TROUBLESHOOTING GUIDE (Con't)

SYMPTOM	POSSIBLE CAUSE	RECOMMENDATION
Low RF Gain (cont)	Defective overdrive circuit	Check for a voltage reading of 1vdc or less on A3Q6 collector. Check associated circuit voltages as indicated on schematic diagram 6-1.
Incorrect output meter indication	Improper Calibration of the METER	Perform meter calibration procedure paragraph 5.8.
	Defective meter	The front panel meter M1 has a 100 ua movement. A defective meter can be found by subsituting a laboratory meter.
	Defective metering circuit	Check metering circuit on the front panel and the A3 Power Supply PCB with an ohmmeter. Replace defective component.
Meter reads other than zero when unit switched off	Incorrect mechanical zero of meter movement	Adjust meter mechanical zero adjustment screw for zero.
Meter reads clockwise from zero when unit switched on.	Detector bias circuit faulty.	Check for presence of +20 vdc regulated at A1E1 and approximately .5 vdc at A1E2. If A1E2 voltage is other than approximately .5 vdc, check that the turret is in a detent position. Using an ohmmeter, check the forward and reverse characteristics of the detector diodes. Be sure to follow normal precautions when using an ohmmeter on semiconductors.

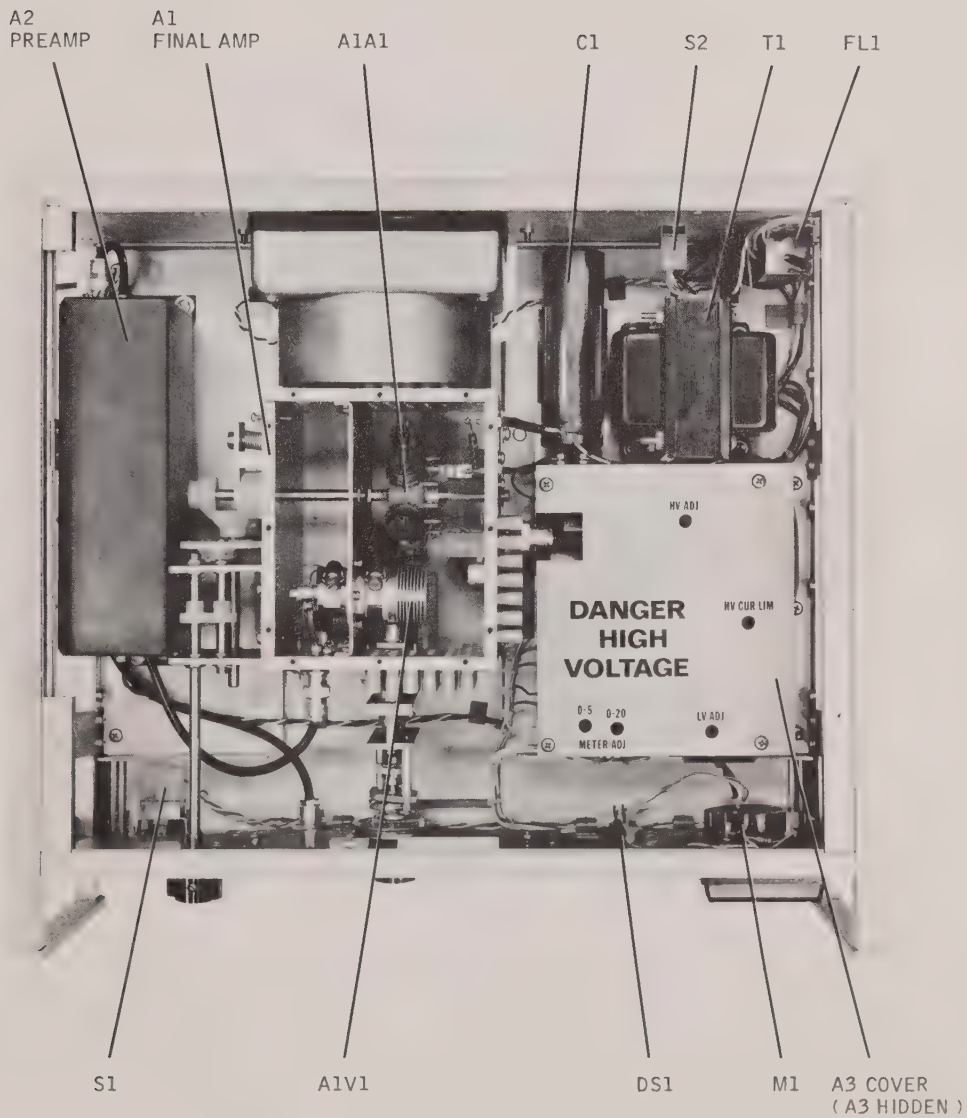


Figure 5-1. Overall Top View with A1 Cover Removed

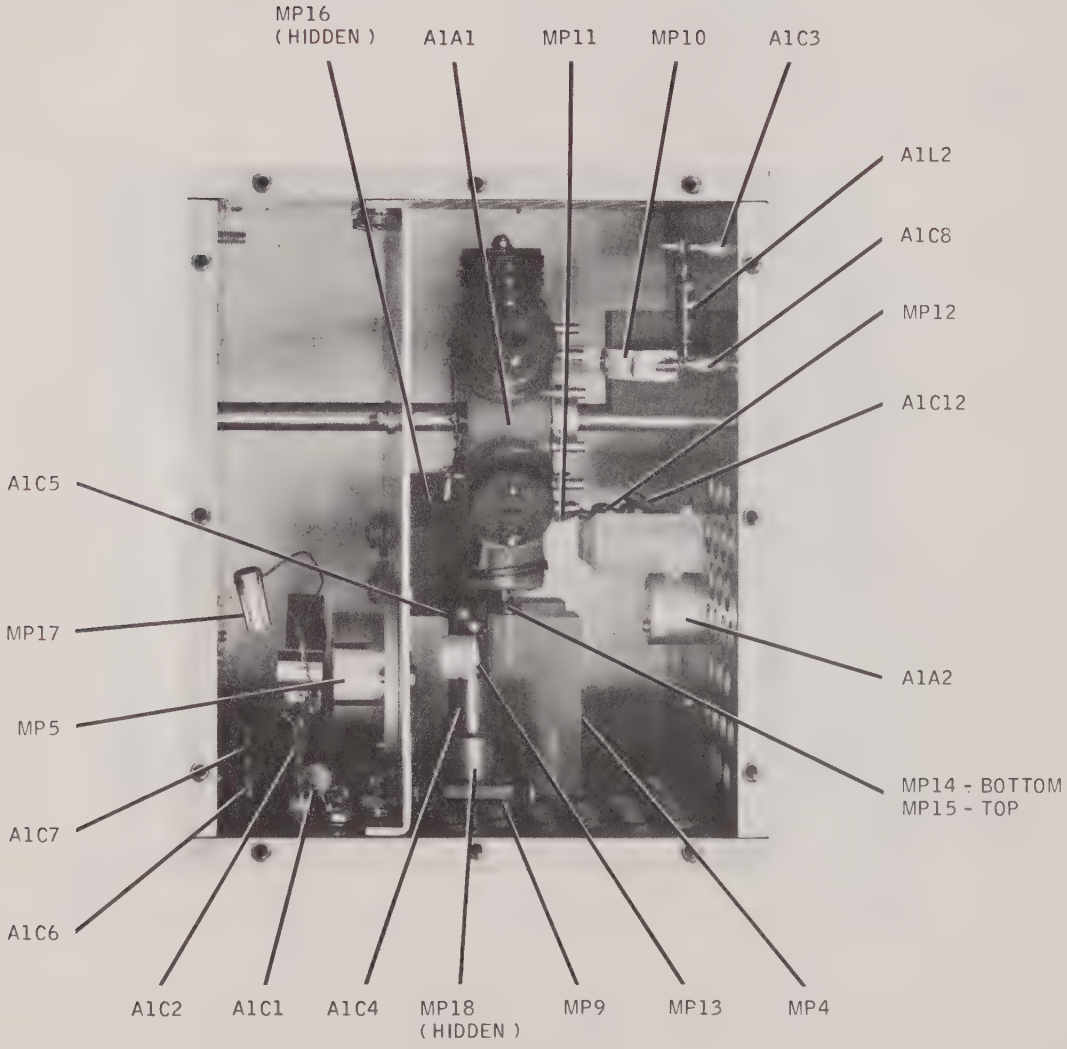


Figure 5-2. Detail of A1 Assembly with Tube Removed.

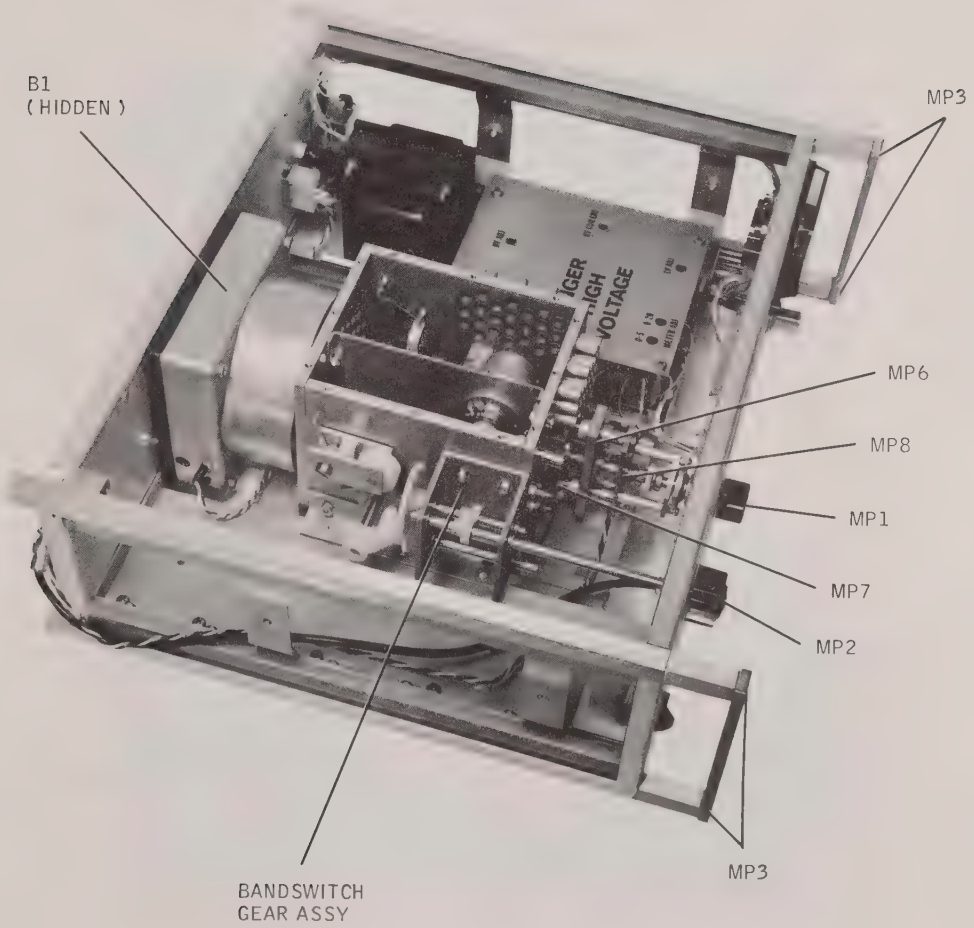


Figure 5-3. Side View of A1 Amplifier Assembly.

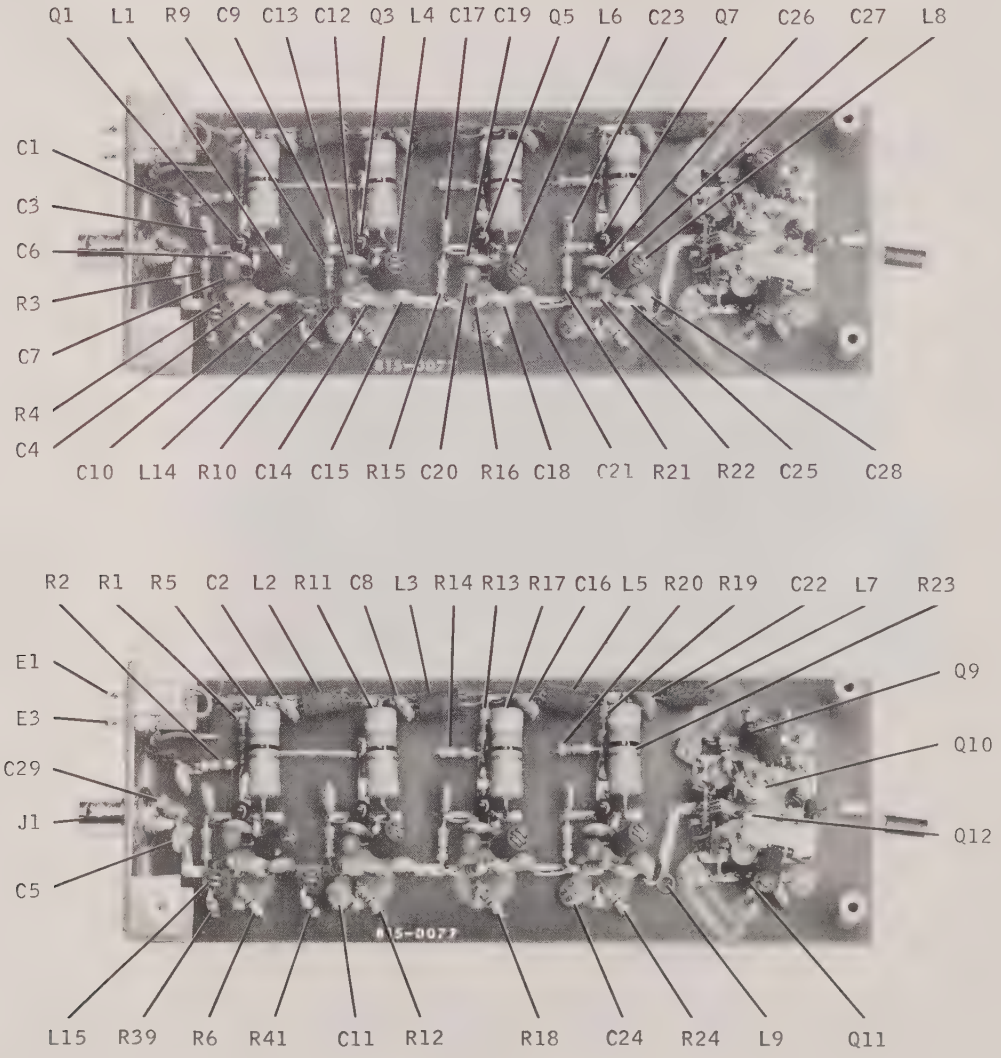


Figure 5-4. A2 Preamp Assembly, Top View Component Locations

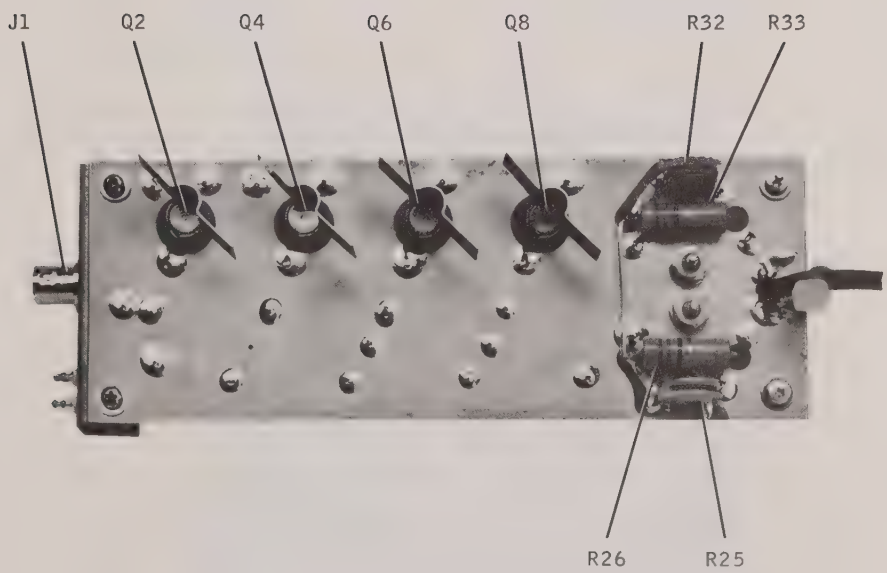


Figure 5-5. A2 Preamp Assembly, Bottom View, Component Locations.

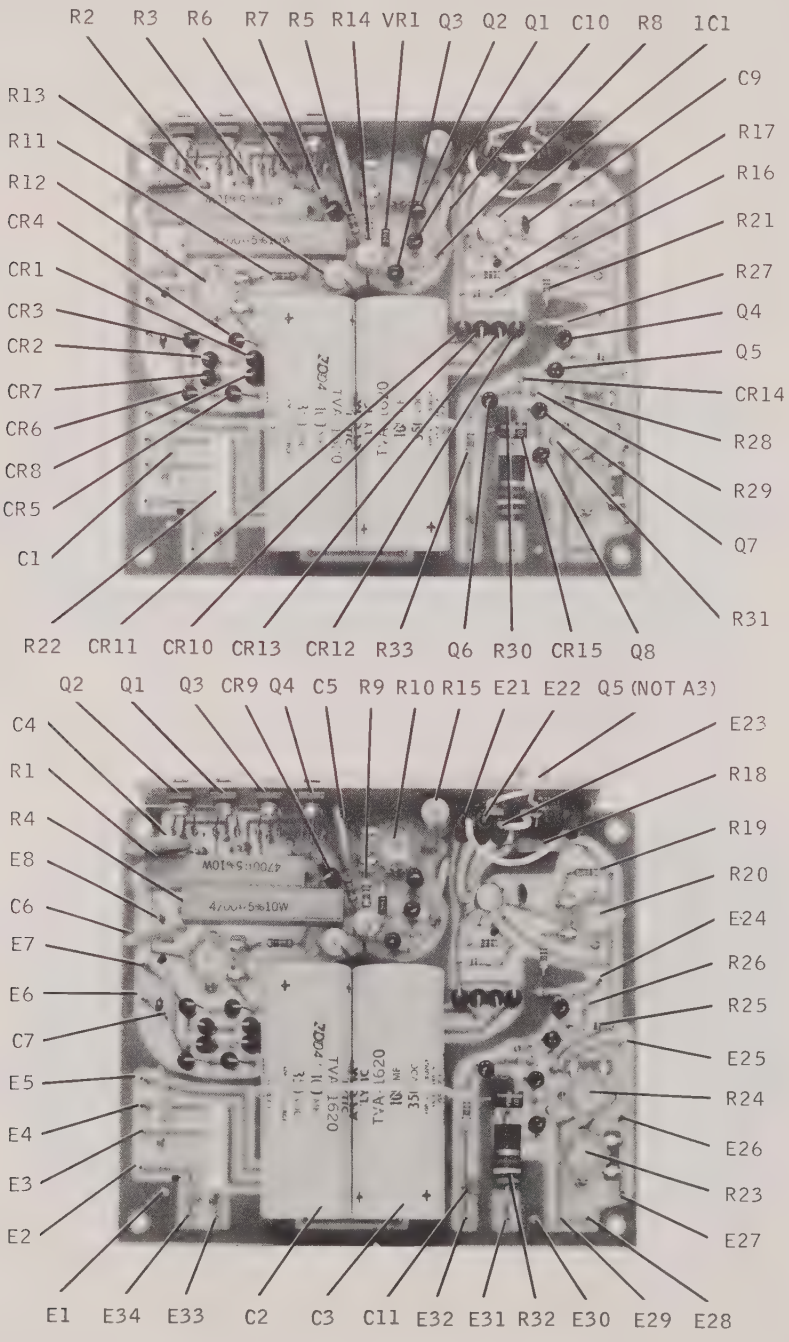


Figure 5-6. A3 Power Supply Assembly, Component Locations.

CHAPTER 6
PARTS LIST AND SCHEMATICS

6.1 PARTS LIST.

Table 6-1 provides listings of all electrical parts and those mechanical parts which might be required for replacement purposes. Electrical parts are listed by assembly and in alpha-numeric order of reference designations as marked on the schematic diagram. Listings include a description of the part, the part number, and a supplier's code number. Table 6-2 provides a reference glossary of abbreviations used in the parts list and elsewhere in the manual.

6.2 LIST OF MANUFACTURERS.

Table 6-3 provides a correlation of the federal supplier's code numbers used in the parts list with the names and addresses of the typical manufacturers. If RF Communications' supplier code number (14304) appears, that part must be obtained directly from RF Communications, Inc. Otherwise, the part optionally may be obtained from your local parts distributor.

6.3 ORDERING REPLACEMENT PARTS.

To obtain replacement parts, address order or inquiry to your local RF Communications, Inc. representative. Identify parts by the part number and the manufacturer code number as listed in the parts list.

To obtain a part which is not listed, include:

a. Instrument model number.
b. Instrument serial number.
c. Description of the part.
d. Function and location of the part.

6.4 SCHEMATIC DIAGRAM.

A complete schematic diagram for the instrument appears in figure 6-1.

TABLE 6-1. REPLACEMENT PARTS LIST

REF DESIG	DESCRIPTION	FSC	MFR PART NO.	TQ	RS
--	MAIN FRAME ASSY:	-----	-----	--	--
B1	Fan	14304	BX158051	1	.1
C1	Capacitor, electrolytic, 5500uF, 40VDCW	14304	CX02552400	1	.1
DS1	Indicator Lamp Assembly	14304	DS05227060	1	.2
F1	Fuse, 3AG, slo-blo:				
	115V, 3 AMP	75915	313000-3 AMP	1	2
	230V, 1.5 AMP	75915	313000-1.5 AMP	--	2
FL1	Line filter assy	14304	808-0102	1	.1
J1-J2	Receptacle , type "N", SPECIAL	14304	MOD. UG-556B/U	2	.2
M1	Meter	14304	MX068151	1	.1
P1	Line cord	14304	WX050000	1	--
P2-P3	Plug, type "BNC"	96918	UG-88E/U	3	--
Q1-Q4	Transistor	14304	QX050340	4	.4
Q5	Transistor, 2N3054	02735	2N3054	1	.1
R1	Resistor, film 15K, $\frac{1}{4}$W, 5%	87730	LCA0309(15K)	1	.1
R2	Resistor, film, 220K, $\frac{1}{4}$W, 5%	87730	LCA0309 (220K)	1	.1
S1	Switch, rocker, dpdt, with lamp	14304	SX071022	1	.1
S2	Switch, slide, dpdt	14304	SX090022	1	.1
S3	Switch, slide, dpdt	14304	SX090122	1	.1
T1	Power transformer	14304	TX918151	1	.1
XF1	Fuseholder	14304	XX020000	1	.1
--	MAIN FRAME MISC. PARTS:	-----	-----	--	--
--	Front panel complete assembly	14304	815-0063	1	.1
--	Rear panel complete assembly	14304	815-0060	1	.1
MP1	Knob	14304	MP918151	1	.1
MP2	Knob	14304	MP918152	1	.1
MP3	Screw, oval pan head 82° C' SK	14304	8-32UNC-2AX2$\frac{1}{4}$LG	4	.4
--	Insulated shoulder washer	72653	6525-C	2	.2
--	Dial window	14304	815-0056	1	.1
--	Dial cord, 36 inch	72653	89-25 MED (.040)	1	.2

NOTE: TQ is total number per unit. RS is recommended spare parts quantity to support one unit for one year. Multiply (RS) by number of units, and round off to next whole number.

TABLE 6-1. REPLACEMENT PARTS LIST (CON'T)

REF DESIG	DESCRIPTION	FSC	MFR PART NO.	TQ	RS
--	Adjustment tool	14304	TL815-1	1	.2
--	Dial pointer assy	14304	815-0047	1	.1
--	Indicator fastener for DS1	78553	C518-020	1	.2
--	Fan blade	14304	BX208051	1	.1
--	Insulated feedthru terminal	74970	260-301	1	.1
A1	OUTPUT AMPLIFIER ASSEMBLY	14304	815-0062	1	.1
A1A1	Turret assy (non-repairable)	14304	815-0006	1	.1
A1A2	Detector assy (non-repairable)	14304	815-0065	1	.1
A1C1	Capacitor, disc ceramic, 4.7pF $\pm$.25pF, NPO, 500 VDCW	91418	CG (4.7pF)	2	.2
A1C2	Capacitor, disc ceramic, .01uF, GMV, 1KVDCW	91418	B(.01uF) .770 DIA.	6	.6
A1C3	Capacitor, feedthru, .0025uF, GMV, 500 VDCW	14304	CX162252	4	.4
A1C4	Capacitor, glass piston	14304	815-0082	1	.1
A1C5	Capacitor, glass piston	14304	815-0079	1	.1
A1C6-C8	Same as A1C3	-----	-----	--	--
A1C10-C11	Capacitor, disc ceramic, .01uF, +80-20%, 25 VDCW	91418	MZ5 (.01UF)	35	3.5
A1C12	Same as A1C1	-----	-----	--	--
A1J1-J2	Receptacle, type "BNC"	96918	KC-79-94	2	--
A1L1	Rf choke assy	14304	LX908151	1	.1
A1L2	Rf choke 33uH	14304	LX018151	1	.1
A1R1	Resistor, film, 390K, 5%, $\frac{1}{4}$W	87730	LCA0309 (390K)	1	.1
A1R2	Resistor, film, 22K, 5%, $\frac{1}{4}$W	87730	LCA0309 (22K)	1	.1
A1V1	Electron tube, 2C39A	14304	VX108151	1	1
--	MISC. PARTS ON ASSY A1:	-----	-----	--	--
MP4	Capacitor mount block	14304	815-0041	1	.1
--	Rf gasket	14304	815-0010	1	.1
MP5	Tube mount	14304	815-0053	1	.1
MP6	Plate, lead screw mounting	14304	815-0025	1	.1
MP7	Plate mount, freq. adjust	14304	815-0026	1	.1
MP8	Plate mount, freq. adjust	14304	815-0027	1	.1
MP9	Capacitor mount block	14304	815-0057	2	.2
MP10	Contact assy	14304	815-0064	1	.1
MP11	Contact	14304	815-0045	2	.2
MP12	Contact	14304	815-0046	1	.1
MP13	Strip, contact	14304	815-0054	1	.1
--	Retainer ring, $\frac{1}{4}$ inch dia.	97464	5100-25	7	.2
MP14	Contact	14304	815-0043-1	1	.2

TABLE 6-1. REPLACEMENT PARTS LIST (CON'T)

REF DESIG	DESCRIPTION	FSC	MFR PART NO.	TQ	RS
MP15	Contact	14304	815-0043-2	1	.2
MP16	Contact, shorting	14304	815-0080	1	.2
--	Ball Drive Assy	14304	815-0123	1	.1
--	Retaining ring, 3/16 inch dia	97464	5100-18	1	.1
--	40/48 nylon gear	14304	815-0117	1	.1
--	80/48 nylon gear	14304	815-0120	1	.1
--	18/32 nylon gear	14304	815-0121	2	.1
--	Nylon miter gear	14304	815-0122	2	.1
--	Tube clamp (hoseclamp type)	08484	QS800-M1OH	2	.1
--	Component clip, 5/16 inch	07387	3B573	1	.1
MP17	Tube, contact	14304	815-0076	1	.1
MP18	Contact, finger	14304	815-0106	2	.2
--	Lead Screw and Nut Assy	14304	815-0078	1	.1
A2	PREAMP/DRIVER ASSEMBLY	14304	815-0111	1	--
--	Preamp PCB only (with parts)	14304	815-0103	1	.1
A2C1-A2C6	Same as A1C10	-----	-----	--	--
A2C7	Capacitor, tantalum , 6.8uF, 35VDCW	14304	CX15068350	6	.6
A2C8-C10	Same as A1C10	-----	-----	--	--
A2C11	Capacitor, disc ceramic, 8.2pF ±20%, 500VDCW	91418	CG8.2NP0±20%	2	.2
A2C12	Same as A1C10	-----	-----	--	--
A2C13	Same as A2C7	-----	-----	--	--
A2C14-C19	Same as A1C10	-----	-----	--	--
A2C20	Same as A2C7	-----	-----	--	--
A2C21-C23	Same as A1C10	-----	-----	--	--
A2C24	Same as A2C11	-----	-----	--	--
A2C25-C26	Same as A1C10	-----	-----	--	--
A2C27	Same as A2C7	-----	-----	--	--
A2C28	Same as A1C10	-----	-----	--	--
A2C29	Capacitor, disc ceramic, 3.3pF, 20%, NPO, 500VDCW	91418	CG3.3 NPO ±20%	1	.1
A2C30-C31	Same as A1C10	-----	-----	--	--
A2C32	Capacitor, ceramic, 10pF, 20%, NPO, 500VDCW	91418	CG10 NPO ±20%	2	.2
A2C33-C36	Same as A1C10	-----	-----	--	--
A2C37	Same as A2C32	-----	-----	--	--
A2C38-C41	Same as A1C10	-----	-----	--	--
A2E1-E3	Feedthru terminal	74970	260-300-01	3	.3
A2J1	Receptacle, type "BNC"	96918	UG-625	2	--
A2L1-L8	Ferrite bead choke	14304	EX140001	12	1.2

TABLE 6-1. REPLACEMENT PARTS LIST (CON'T)

REF DESIG	DESCRIPTION	FSC	MFR PART NO.	TQ	RS
A2L9	Choke, rf	14304	LX908152	1	--
A2L10	Same as A2L1	-----	-----	--	--
A2L11	Choke, rf	14304	LX908153	1	--
A2L12	Same as A2L1	-----	-----	--	--
A2L13	Same as A2L11	-----	LX908153	1	--
A2L14-L15	Same as A2L1	-----	-----	--	--
A2P1	Same as P2 (main frame)	-----	-----	--	--
A2Q1	Transistor, 2N5138	07263	2N5138	7	.7
A2Q2	Transistor, 2N5109	02735	2N5109	4	.4
A2Q3	Same as A2Q1	-----	-----	--	--
A2Q4	Same as A2Q2	-----	-----	--	--
A2Q5	Same as A2Q1	-----	-----	--	--
A2Q6	Same as A2Q2	-----	-----	--	--
A2Q7	Same as A2Q1	-----	-----	--	--
A2Q8	Same as A2Q2	-----	-----	--	--
A2Q9	Same as A2Q1	-----	-----	--	--
A2Q10	Transistor	14304	QX958151	2	.2
A2Q11	Same as A2Q1	-----	-----	--	--
A2Q12	Same as A2Q10	-----	-----	--	--
A2R1	Resistor, film, 470 ohms, 5%, $\frac{1}{4}$W	87730	LCA0309 (470)	3	.3
A2R2	Resistor, film, 1.8K, 5%, $\frac{1}{4}$W	87730	LCA0309 (1.8K)	1	.1
A2R3	Resistor, film, 820 ohms, 5%, $\frac{1}{4}$W	87730	LCA0309 (820)	5	.5
A2R4	Resistor, film, 150 ohms, 5%, $\frac{1}{4}$W	87730	LCA0309 (150)	5	.5
A2R5	Resistor, film, 47 ohms, 5%, 2W	87730	LCA0922 (47)	4	.4
A2R6	Resistor, film, 15 ohms, 5%, $\frac{1}{4}$W	87730	LCA0309 (15)	4	.4
A2R7-R8	Not assigned	-----	-----	--	--
A2R9	Same as A2R3	-----	-----	--	--
A2R10	Same as A2R4	-----	-----	--	--
A2R11	Same as A2R5	-----	-----	--	--
A2R12	Same as A2R6	-----	-----	--	--
A2R13	Same as A2R1	-----	-----	--	--
A2R14	Resistor, film, 1.8K, 5%, $\frac{1}{4}$W	87730	LCA0309 (1.8K)	--	--
A2R15	Same as A2R9	-----	-----	--	--

TABLE 6-1. REPLACEMENT PARTS LIST (CON'T)

REF DESIG	DESCRIPTION	FSC	MFR PART NO.	TQ	RS
A2R16	Same as A2R4	-----	-----	--	--
A2R17	Same as A2R5	-----	-----	--	--
A2R18	Same as A2R6	-----	-----	--	--
A2R19	Same as A2R1	-----	-----	--	--
A2R20	Resistor, film, 1.5K, 5%, $\frac{1}{4}$W	87730	LCA0309 (1.5K)	2	.2
A2R21	Resistor, film, 330 ohms, 5%, $\frac{1}{4}$W	87730	LCA0309 (330)	1	.1
A2R22	Same as A2R4	-----	-----	--	--
A2R23	Same as A2R5	-----	-----	--	--
A2R24	Same as A2R6	-----	-----	--	--
A2R25	Potentiometer, PCB MTG 2.5K	14304	RX200252	2	.2
A2R26	Resistor, film, 27 ohms, 5%, 2W	87730	LCA0922 (27)	2	.2
A2R27	Same as A2R3	-----	-----	--	--
A2R28-R29	Resistor, film, 10 ohms, 5%, $\frac{1}{4}$W	87730	LCA0309 (10)	4	.4
A2R30	Resistor, film, 270 ohms, 5%, $\frac{1}{4}$W	87730	LCA0309 (270)	2	.2
A2R31	Resistor, film, 220 ohms, 5%, $\frac{1}{4}$W	87730	LCA0309 (220)	4	.4
A2R32	Same as A2R25	-----	-----	--	--
A2R33	Same as A2R26	-----	-----	--	--
A2R34	Same as A2R3	-----	-----	--	--
A2R35	Same as A2R30	-----	-----	--	--
A2R36-R37	Same as A2R28	-----	-----	--	--
A2R38	Same as A2R31	-----	-----	--	--
A2R39	Resistor, film, 100 ohms, 5%, $\frac{1}{4}$W	87730	LCA0309 (100)	3	.3
A2R40	Same as A2R31	-----	-----	--	--
A2R41	Same as A2R39	-----	-----	--	--
A2R42	Same as A2R31	-----	-----	--	--
A2T1	Xfmr, RF	14304	TX928151	2	.2
A2T2	Xfmr, RF	14304	TX928152	2	.2
A2T3	Same as A2T2	-----	-----	--	--
A2T4	Same as A2T1	-----	-----	--	--
A2T5	Xfmr, RF	14304	TX928153	1	.1
--	MISC. PARTS ON ASSY A2:				
--	Connector mounting bracket	14304	815-0099	1	.1

TABLE 6-1. REPLACEMENT PARTS LIST (CON'T)

REF DESIG	DESCRIPTION	FSC	MFR PART NO.	TQ	RS
A3	POWER SUPPLY/CONTROL ASSEMBLY	14304	815-0066	1	.1
A3C1	Same as A1C2	-----	-----	--	--
A3C2-C3	Capacitor, electrolytic, 100uF, 350 VDCW	56286	Atomlytic 100/350V	1	.1
A3C4-C7	Same as A1C2	-----	-----	--	--
A3C8	Not assigned	-----	-----	--	--
A3C9	Capacitor, disc ceramic, 680pF, GMV, 500 VDCW	91418	JG 680 10%	1	.1
A3C10	Same as A1C10	-----	-----	--	--
A3C11	Same as A2C7	-----	-----	--	--
A3CR1-CR13	Diode, silicon,	14304	CR918051	14	1.4
A3CR14	Diode, silicon, 1N914	93332	1N914	1	.1
A3CR15	Same as A3CR1	-----	-----	--	--
A3IC1	Integrated circuit	14304	IC0520723	1	.1
A3Q1-Q4	Transistor	14304	QX055172	7	.7
A3Q5	Same as A2Q1	-----	-----	--	--
A3Q6-Q8	Same as A3Q1	-----	-----	--	--
A3R1	Resistor, wirewound, 4.7K, 5%, 10W	07675	4.7K, 5%, 10W	2	.2
A3R2	Resistor, film, 5.6K, 5%, $\frac{1}{4}$W	87730	LCA0309 (5.6K)	2	.2
A3R3	Resistor, film, 2.2K, 5%, $\frac{1}{4}$W	87730	LCA0309 (2.2K)	2	.2
A3R4	Same as A3R1	-----	-----	--	--
A3R5	Same as A3R2	-----	-----	--	--
A3R6	Same as A3R3	-----	-----	--	--
A3R7	Resistor, film, 22 ohms, 5%, $\frac{1}{4}$W	87730	LCA0309 (22)	1	.1
A3R8	Resistor, film, 3.3K, 5%, $\frac{1}{4}$W	87730	LCA0309 (3.3K)	2	.2
A3R9	Resistor, film, 1K, 5%, $\frac{1}{4}$W	87730	LCA0309 (1K)	2	.2
A3R10	Potentiometer, PCB MTG, 10K	14304	RX201103	2	.2
A3R11	Resistor, film, 6.8K, 5%, $\frac{1}{4}$W	87730	LCA0309 (6.8K)	1	.1
A3R12	Same as A3R10	-----	-----	--	--
A3R13	Resistor, film, 150 ohms, 5%, 2W	87730	LCA0922 (150)	1	.1
A3R14	Resistor, film, 220K, 5%, 2W	87730	LCA0922 (220K)	1	.1
A3R15	Resistor, film 330K, 5%, 2W	87730	LCA0922 (330K)	1	.1

TABLE 6-1. REPLACEMENT PARTS LIST (CON'T)

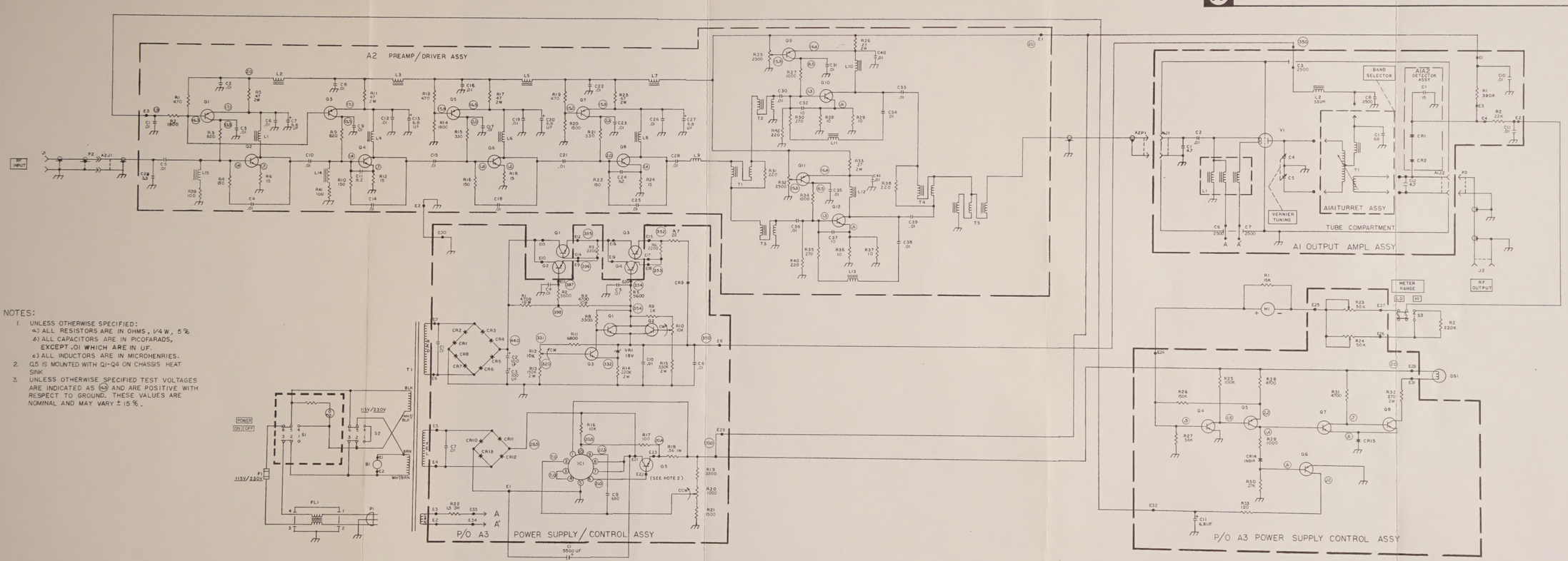
REF DESIG	DESCRIPTION	FSC	MFR PART NO.	TQ	RS
A3R16	Resistor, film 10K, 5%, $\frac{1}{4}$W	87730	LCA0309 (10K)	1	.1
A3R17	Same as A2R39	-----	-----	--	--
A3R18	Resistor, wirewound, 0.56 ohm, 5%, 1W	87730	SKA-1W'M110	1	.1
A3R19	Same as A3R8	-----	-----	--	--
A3R20	Potentiometer, PCB MTG 1K	14304	RX201102	1	.1
A3R21	Same as A2R20	-----	-----	--	--
A3R22	Resistor, wirewound, 1.5 ohm, 5%, 1W	00213	SAGE 1200S	1	.1
A3R23	Potentiometer, PCB MTG 50K	14304	RX201503	2	.2
A3R24	Same as A3R23	-----	-----	--	--
A3R25	Resistor, film, 100K, 5%, $\frac{1}{4}$W	87730	LCA0309 (100K)	1	.1
A3R26	Same as A2R4	-----	-----	--	--
A3R27	Resistor, film, 56K, 5%, $\frac{1}{4}$W	87730	LCA0309 (56K)	1	.1
A3R28	Resistor, film, 4.7K, 5%, $\frac{1}{4}$W	87730	LCA0309 (4.7K)	2	.2
A3R29	Same as A2R3	-----	-----	--	--
A3R30	Resistor, film, 27K, 5%, $\frac{1}{4}$W	87730	LCA0309 (27K)	1	.1
A3R31	Same as A3R28	-----	-----	--	--
A3R32	Resistor, film, 270 ohms, 5%, 2W	87730	LCA0922 (270)	1	.1
A3VR1	Diode, zener, 18 volts, 1N967B	04713	1N967B	1	.1

TABLE 6-2. GLOSSARY OF ABBREVIATIONS

amp	amperes	mw	milliwatts
ampl	amplifier	pcb	printed-circuit board
assy	assemblies	pf	picofarads
bkt	bracket	pot.	potentiometer
cap.	capacitor	res	resistor
cer	ceramic	sil	silicon
dia	diameter	tant	tantalum
dpdt	double-pole, double-throw	uf	microfarads
elect.	electrolytic	v	volts
ger	germanum	var	variable
in.	inches	vdcw	dc working volts
k	kilohms	w	watts
mego	megohms	ww	wirewound
mtd	mounted	xfmr	transformer
mtg	mounting	xstr	transistor

TABLE 6-3. LIST OF MANUFACTURERS

FSC #	MANUFACTURER	ADDRESS
00213	Sage Electronics Corp.	Rochester, N. Y.
02735	RCA	Somerville, N. J.
04713	Motorola Semiconductor Prods.	Phoenix, Ariz.
07263	Fairchild Camera and Instrument Corp.	Mt. View, Calif.
07387	Birtcher Corp.	Los Angeles, Calif.
07675	Hamilton & Hall Mfg. Co.	Milwaukee, Wis.
08484	Breeze Corp.	Union, N. J.
09109	Winzeler Mfg. & Tool Co.	Harwood Heights, Ill.
14304	RF Communications, Inc.	Rochester, N. Y.
56289	Sprague Electric Co.	North Adams, Mass.
72653	GC Electronics Corp.	Rockford, Ill.
74970	E. F. Johnson	Waseca, Minn.
75195	Littlefuse, Inc.	Des Plaines, Ill.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
87730	United Mineral & Chemical Corp.	New York, N. Y.
91418	Radio Materials Co.	Chicago, Ill.
93332	Syvania Semiconductor Prod. Div.	Hillsboro, N. H.
96918	Kings Electronic	Tuckahoe, N. Y.
97464	Industrial Retaining Rings Co.	Irvington, N. J.

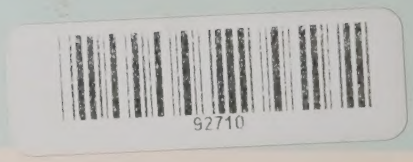


NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a.) ALL RESISTORS ARE IN OHMS, 1/4 W, 5%
   b.) ALL CAPACITORS ARE IN PICOFARADS, EXCEPT .01 WHICH ARE IN UF.
   c.) ALL INDUCTORS ARE IN MICROHENRIES.
2. Q5 IS MOUNTED WITH Q1-Q4 ON CHASSIS HEAT SINK
3. UNLESS OTHERWISE SPECIFIED TEST VOLTAGES ARE INDICATED AS (xx) AND ARE POSITIVE WITH RESPECT TO GROUND. THESE VALUES ARE NOMINAL AND MAY VARY ± 15%.

RF-815 AMPLIFIER

Figure 6-1. RF-815 Amplifier, Schematic Diagram



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rf